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3D Geological Model for "LUSI" - a Deep Geothermal System

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Geothermal applications require the correct simulation of flow and heat transport processes in porous media, and many of these media, like deep volcanic hydrothermal systems, host a certain degree of fracturing. This work aims to understand the heat and fluid transport within a new-born sedimentary hosted geothermal system, termed Lusi, that began erupting in 2006 in East Java, Indonesia. Our goal is to develop conceptual and numerical models capable of simulating multiphase flow within large-scale fractured reservoirs such as the Lusi region, with fractures of arbitrary size, orientation and shape. Additionally, these models can also address a number of other applications, including Enhanced Geothermal Systems (EGS), CO_2 sequestration (Carbon Capture and Storage CCS), and nuclear waste isolation. Fractured systems are ubiquitous, with a wide-range of lengths and scales, making difficult the development of a general model that can easily handle this complexity.

We are developing a flexible continuum approach with an efficient, accurate numerical simulator based on an appropriate 3D geological model representing the structure of the deep geothermal reservoir. Using previous studies, borehole information and seismic data obtained in the framework of the Lusi Lab project (ERC grant n°308126), we present here the first 3D geological model of Lusi. This model is calculated using implicit 3D potential field or multi-potential fields, depending on the geological context and complexity. This method is based on geological pile containing the geological history of the area and relationship between geological bodies allowing automatic computation of intersections and volume reconstruction. Based on the 3D geological model, we developed a new mesh algorithm to create hexahedral octree meshes to transfer the structural geological information for 3D numerical simulations to quantify Thermal-Hydraulic-Mechanical-Chemical (THMC) physical processes.